

What is claimed is:

1. A method of forming patterned, porous material on a substrate, comprising:
  - 5    a. depositing a layer onto a substrate, said layer comprising a reactive organosilicate material, a porogen, an initiator, and a solvent;
  - b. exposing portions of the layer to radiation to change the solubility of portions of the organosilicate material with respect to the solvent;
- 10    c. selectively removing more soluble portions of the layer to generate a relief pattern; and
- d. removing the porogen to thereby generate a porous organosilicate layer.
- 15    2. The method of Claim 1, wherein the layer is nanoporous.
3. The method of Claim 1, wherein said removing the porogen is performed after selectively removing portions of the layer.
- 20    4. The method of Claim 1, wherein said removing the porogen is performed while selectively removing portions of the layer.
5. The method of Claim 1, wherein the solubility of the organosilicate material decreases within the exposed portions, and said method comprises removing unexposed portions of the layer.
- 25    6. The method of Claim 1, wherein the solubility of the organosilicate material increases within the exposed portions, and said method comprises selectively removing exposed portions of the layer.

7. The method of Claim 1, wherein the organosilicate material is a silsesquioxane and comprises (RSiO<sub>1.5</sub>) where R is independently hydrogen, or a methyl, ethyl, higher alkyl, vinyl, aryl, phenyl or substituted phenyl group.

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8. The method of Claim 7, wherein the silsesquioxane further comprises at least one comonomer chosen from the group consisting of (Si(R)O<sub>1.5</sub>), (SiO<sub>2</sub>), (SiR<sub>2</sub>O), and (SiR SiO<sub>3</sub>).

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9. The method of Claim 7, wherein the silsesquioxane has from 10 to 500 repeating units.

10. The method of Claim 1, wherein the porogen nucleates, grows, and phase separates during crosslinking of the silsesquioxane matrix.

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11. The method of Claim 10, wherein the porogen is a star polymer.

12. The method of Claim 10, wherein the porogen is chosen from the group consisting of linear and hyperbranched macromolecules.

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13. The method of Claim 10, wherein the porogen comprises a polymer chosen from the group consisting of polyalkylene oxides including poly(ethylene oxide), poly(propylene oxide) and copolymers thereof, polyacrylates, polyacrylamides, aliphatic polycarbonates, aliphatic polysulfones, polylactones, polylactides, polystyrenes, substituted polystyrenes, poly(ether-lactones), poly(lactone-lactides), polyalkylene copolymers, poly(caprolactone - co-valerolactone), nitrogenous methacrylate copolymers, and nitrogenous vinyl copolymers.

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30 14. The method of Claim 1, wherein the porogen is a template for forming pores within the silsesquioxane matrix.

15. The method of Claim 14, wherein the porogen comprises a multiarm radial block copolymer having an amphiphilic structure with a hydrophobic core and a hydrophilic corona.
- 5        16. The method of Claim 14, comprising generating particle like behavior for templating from a non-crosslinked amphiphile by selective block collapse thereof.
- 10      17. The method of Claim 14, wherein the porogen comprises a multiarm radial block copolymer having an amphiphilic structure with a hydrophobic core and a hydrophilic corona, at least one of said core and corona being crosslinked.
- 15      18. The method of Claim 14, wherein the porogen comprises a crosslinked nanoparticle prepared by a process chosen from the group consisting of microemulsion polymerization and suspension polymerization.
19. The method of Claim 18, wherein the hydrophobic core comprises a nonpolar polymer.
- 20      20. The method of Claim 19, wherein the nonpolar polymer for the core is selected from the group consisting of polystyrene, poly  $\alpha$ -methyl styrene, polynorbonene, polylactones, polylactides, polybutadiene, polyisoprene, polyolefins, and polyisobutylene.
- 25      21. The method of Claim 15, wherein the hydrophilic corona comprises a polar polymer.
22. The method of Claim 20, wherein the polar polymer is selected from the group consisting of polyethyleneglycol, polypropylene glycol, polyhydroxyalkylmethacrylate, polyalkyleneoxide acrylates, polyalkyleneoxide methacrylates, sugars, carbohydrates, polyvinyl alcohol, polyethyleneimines, polyoxazolines, polypeptides, polyvinylpyridines, acrylamides, and N,N-dimethylacrylamides.
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23. The method of Claim 1, wherein the initiator is activated by electromagnetic energy chosen from the group consisting of e-beam radiation, ionizing radiation, and photons, and the initiator is chosen from the group consisting of acid generators and base generators, and free radicals.

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24. The method of Claim 1, comprising removing the porogen by a process chosen from the group consisting of exposure to ultraviolet radiation, thermolysis, ozonolysis, plasma oxidation, solvent extraction, and supercritical fluid extraction.

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25. A method of forming patterned, nanoporous material on a substrate, comprising:

a. depositing a layer onto a substrate, said layer comprising:

- (i) an organosilicate,
- 15 (ii) a porogen as a template for forming pores within the organosilicate said porogen comprising a multiarm radial block copolymer having an amphiphilic structure with a core and a corona, one of the core and the corona being hydrophobic, and the other of the core and the corona being hydrophilic,
- 20 (iii) an initiator, and
- (iv) a solvent;

b. exposing portions of the layer to radiation to change the solubility of portions of the organosilicate with respect to the solvent;

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c. selectively removing more soluble portions of the layer to generate a relief pattern; and

d. removing the porogen to thereby generate a nanoporous layer.

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26. The method of Claim 25, wherein the organosilicate is a silsesquioxane and comprises (RSiO<sub>1.5</sub>) where R is independently hydrogen, or a methyl, ethyl, higher alkyl, vinyl, aryl, phenyl or substituted phenyl group.